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THE CONTINUING PROGRESS OF CANCER RESEARCH[1]

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DURING a period of serious difficulty in the adjustment of human relationships throughout the world we find ourselves engaged in the consideration of a campaign against a common enemy of mankind which still defies us and which we do not quite fully understand. The worker in the field of cancer research sometimes feels discouraged because progress has been less rapid than he had hoped. The general public also appears to have the impression that cancer research is not making very rapid progress. In fact, however, there are many reasons for optimism. A comparison of the present outlook in regard to malignant disease with that of thirty years ago will indicate that a very marked advance has been accomplished. It is, however, quite evident that continued effort in cancer research must be maintained. The lengthening of the average life of the human individual has served to increase the population in the older periods of life and it is in these age periods that malignant disease is most prevalent. For this very reason we have to expect a continuing increase in the incidence and death rate from malignant disease for some time to come. Modern civilization has also made the lives of persons beyond fifty years of age of greater value to the community, and it is becoming increasingly important to preserve these individuals in a state of efficiency for the service of humanity. Nowhere will one find any outcry against the expenditure of effort in the study of cancer except from those who feel that these efforts are being misdirected or are utterly futile.

The precise nature of malignant neoplastic disease can not be said to be fully elucidated as yet. In the study of a disease process a beginning is ordinarily

[1] Address of the president of the American Association for Cancer Research, Toronto, March 28, 1934.

made by the examination of symptoms and gross signs of the disease. This is followed by a study of the anatomical structure, both gross and microscopic, and finally there is an attempt to ascertain the relationships of cause and effect which we ordinarily class under the study of etiology. Some advance has been made in all these fields in recent years. In the clinical field of symptomatology we have learned that emaciation, severe pain and disability are not the ordinary signs of early malignant disease. We have learned that, as a rule, these evidences appear only late in the disease. This recognition is of great importance to the patient, for it places proper emphasis upon the recognition of cancer in the earlier stage before such signs and symptoms have appeared, at a time when the disease may still be regarded as amenable to treatment. This knowledge has been acquired not only by physicians but has been imparted to the public in such a way that now one often sees cancer in a very early stage, so early in fact that one might be justified in stating that the very early cancerous lesion is not particularly dangerous. This changed attitude in regard to symptoms and signs represents an advance in the attitude toward malignant disease of the very greatest practical importance.

Study of the structure of neoplasms has been carried on assiduously by a very large number of scientific investigators. From these studies we have learned the various peculiar structural forms of tumors which are observed in various parts of the body, and by using this knowledge in conjunction with a record of the subsequent history of the individual, there has gradually been accumulated by most painstaking work quite definite criteria to guide the physician in the care of patients presenting each of these various kinds of lesions. In this way a very detailed and elaborate classification of various types of neoplastic growths has been worked out on the basis of the histological elements and their arrangement in the tumor. This work is also of supreme practical importance. At the present day it furnishes the information upon which a diagnosis, prognosis and outline of treatment for the patient must be based.

The earnest student of medicine is not, however, completely satisfied with the knowledge of signs and symptoms and the knowledge of anatomical structure. In the study of neoplastic disease we find numerous investigators who have turned their attention to the question of etiology. There has existed, perhaps, some antagonism between those who have devoted their lives to the study of structure of tumors and those who would make an attempt to ascertain the causative factors by some other method of investigation. This antagonism has certainly been very much ameliorated in the last thirty years, and this amelioration in itself may be looked upon as a distinct advance in cancer research. A tremendous impetus to the study of etiology was given by the recognition of transplantable animal tumors. These tumors occurring in small animals with relatively short duration of life offer the opportunity to study many generations of tumor-bearing animals during the lifetime of one man. Perhaps the chief interest in this field hinges upon the questions of heredity, the influence of irritation and the possible relationship of bacterial agents or filterable agents in the causation of malignant neoplasms.

In regard to heredity, clinical observations on human families had already revealed some striking contrasts. Although the records of human families are far from satisfactory for the purpose, it has, nevertheless, been possible to recognize that there are families in which cancer occurs with unusual frequency and that there are other families in which neoplastic disease as a cause of death is practically unknown, even though the individuals in these latter families attain to old age before death. Apparently there is an actual inheritance of the tendency to suffer from malignant tumors and also an inheritance of resistance to this type of disorder.

From the purely scientific point of view the study of heredity in animals is much more satisfactory. Here the material is subject to more precise control and fairly complete evidence, including post-mortem examination of nearly all individual animals, can be made available. The genetic experts who have devoted attention to the study of cancer heredity in mice are not wholly in agreement in regard to interpretation of observations. However, it is now certain that there are families of mice in which malignant tumors are exceedingly common and that there are other mouse families in which neoplastic disease is practically unknown as a cause of death. It is possible to propagate, by pure line mating, races of mice which will continue to exhibit these phenomena of high cancer incidence or of practical freedom from cancer. The results of cross matings present difficulty in their interpretation. However, it now seems certain that there is something more than a simple genetic heredity involved in cancer of mice. The presence of cancer in the mother seems to be of greater significance in the production of cancer in the offspring than is the presence of malignant disease in the paternal ancestor. Perhaps it would be fair to say that the influence of heredity upon the incidence of cancer can now be clearly recognized as having a real existence, but that there is still lacking the proof that cancer is a genetic disease inherited in the same sense as polydactylism or hemophilia. One is reminded of the old controversy as to whether it is the soil or the disease which is being inherited. It seems

not improbable that the heredity actually has to do with the soil upon which the disease may develop. However, some students of genetics appear to be fully convinced that malignant disease in mice is actually dependent entirely upon genetic factors.

The study of malignant disease in animals has disclosed the fact that this type of disease is much more frequent in such animals as rats and mice, dogs and chickens than it is in cattle, horses, sheep, swine, ducks or geese. The evidence in regard to these latter animals appears to be fairly reliable, because animals used for food are subjected to a reasonably careful inspection in many instances.

The influence of irritation as a factor in production of malignant disease, first recognized by Percivall Pott in 1775, has in recent years commanded more and more attention. In addition to the cancer of chimney sweeps described by Pott it is now possible to recognize with certainty the influence of irritation in causing malignant disease of the mouth, for example, that due to burning the tongue with hot smoke, or that which follows the chewing of particular kinds of irritant vegetable materials, or that which is associated with the continuing irritation of jagged teeth. The influence of irritant chemical substances which are excreted in the urine as well as the influence of the bilharzia disease in the urinary bladder as factors in the incidence of malignant tumors in this region may be considered to be established beyond question. There is also suggestive evidence that irritation and disturbed function play a considerable part in cancer of the breast and uterus in the human being.

In experimental animals it has been possible to obtain a large amount of evidence indicating the positive influence of irritant substances in relation to the occurrence of neoplasms. The effect of aniline dyes and of crude tar itself is now distinctly recognized. Modern refinements of these studies have led to the recognition of quite definite pure chemical substances which exert an important influence in inducing cancer in experimental animals. However, the positive results obtained in this way are not sufficiently constant in any animal species to warrant the statement that such a substance may be looked upon as a specific carcinogenic agent. Especially when one attempts to produce malignant disease in a variety of different animals with such an agent, he finds that positive results are to be expected only in a relatively small number of animals employed for experimentation.

It is perhaps fair to state that prolonged irritation of any region of the human body may be looked upon as a factor favoring the development of malignant tumor in that particular region. It may also be fairly said that the application of irritant substances to various animals serves to bring about the appearance of malignant tumors in a number of such animals in which no tumors would be expected in the absence of such irritation. However, one has to recognize that not every tissue will respond to irritation by the production of a tumor and that there still remains some obscure factor of causation in the tissue which does respond by the production of a tumor. The possible interaction of hereditary influences and irritating factors in the production of neoplastic disease is strongly suggested by the observations made in this field.

The possible importance of microbic agents in causing neoplasm has intrigued the interest of various investigators for the last fifty years. In a disease of plants known as crown gall Dr. Erwin F. Smith was able to recognize a bacterial species as the etiologic agent, and he was inclined to regard the crown gall disease of plants as analogous to cancer of animals. However, it is a far cry from plants to animals and especially to a human being. The various bacteria which have from time to time been found in tumors of man and other mammals are now quite generally regarded as secondary invaders of no actual importance in the causation of the neoplasm as such.

More significance attaches to the observation of filterable agents, especially in the tumors in chickens. It has been possible to separate from such tumors a filterable agent which is either in solution or in such a finely divided state that it will pass through the pores of filters capable of retaining the smallest of the ordinary bacteria. When this filterable agent is introduced into healthy chickens in a suitable manner it is possible to bring about the development of a lesion similar in all respects to the natural neoplasm observed in the original bird. The exact nature of the lesion thus produced has become a subject of some controversy. However, it is only fair to say that these lesions would everywhere be regarded as typical neoplasms, were it not for the fact that a filterable agent has been shown to play a part in their causation. The numerous attempts to extend these observations to other tumors of vertebrate animals have not met with great success. It has been possible, however, to demonstrate a somewhat similar filterable agent in one type of malignant tumor of the mouse.

The nature of the filterable agent of the chicken sarcoma is not clearly established. Apparently the agent belongs to the so-called ultra-visible viruses and exists as particles in suspension, the size of the particles being somewhat less than 30 Ångstrom units in diameter, that is to say 30/1000 of a micron. In respect to size of particle this filterable agent seems to be in the same category as those agents which cause the destruction of bacterial cultures to which has been given the name of bacteriophage. Here also is a filterable agent, the exact nature of which is still

debatable. This agent appears to be able to stimulate a somewhat more active growth of bacterial culture, which is then followed by a disintegration of many of the bacterial cells or sometimes by a complete disintegration of all the cells in a culture. In some respects this phenomenon observed among the bacteria is analogous to malignant disease in the vertebrate, and it seems at least possible that an elucidation of the nature of the filterable agent of the bacteriophage may be helpful in elucidating the problem presented by the filterable agent of the chicken sarcoma.

A field of investigation which has presented many difficulties and which nevertheless seems to promise much for the future is that of artificial culture of neoplastic cells. The cultivation of animal cells in suitable glass containers has been successfully practised for about thirty years. The cultivation of neoplastic cells seems to present new difficulties in comparison with the culture of the cells of normal tissue. However, considerable success has already been attained and it now seems quite certain that the cultures of neoplastic cells tend to disintegrate and die more quickly than do the cultures of normal cells from a similar region of the animal body. Furthermore, in some of these cultures it is possible to recognize various examples of abnormal cell division similar to those which are seen in very actively growing neoplasms in the animal body. The successful culture of neoplastic cells presents many important new possibilities for the investigation of the problem of cancer. The possible existence of recognizable filterable agents in such tissue cultures is one that demands early inquiry.

The general public is chiefly interested in the practical control of cancer and the advocate of cancer research should be in a position to face frankly the challenge as to the practical value of all this abstruse study of malignant disease. Actually there is much reason to be optimistic about the matter. The scientist in his pursuit of truth can not at the moment pay too much attention to practical application. However, it is certain that the facts assembled by the research worker furnish the sound basis upon which one is able to formulate programs for a more effective control of human disease. The experimental study of heredity has already demonstrated conclusively that breeding plays an important part in the incidence of cancer. For a human being to escape malignant disease, therefore, it is important to select one or more ancestors from a line of human individuals who have shown resistance to this type of disease. Perhaps this suggestion may sound absurd, but it nevertheless does have some importance for the future generations. The individual of the cancer family is not necessarily condemned on account of the occurrence of this disease in his relatives, but he will do well in choosing his mate to select one from a family in which this disease has not been prevalent. Apparently for human affairs emphasis should be placed upon the inheritance of resistance to neoplastic disease rather than upon the inheritance of susceptibility. A second practical point of the greatest importance has to do with repeated and long-continued irritations of particular parts of the body. It is perhaps not too much to say that cancer of the mouth cavity is a wholly preventable disease. Irritation and maladjustments of function in other parts of the body should also receive early attention in order to diminish the danger of cancer in these regions.

The clinical and morphological studies of tumors as they present themselves to the surgeon and the pathologist have accumulated an enormous amount of information concerning the course of the various neoplastic diseases in different parts of the body and concerning the best method of their treatment. The general public is becoming cancer conscious so that tumors which show definite external signs are being seen very much earlier by the physician. This is a matter of greatest practical importance. Furthermore, the technical methods of dealing with cancer in various parts of the body have been very much elaborated and improved during the last quarter of a century. Cancer of the skin is by no means as serious a problem to-day as it used to be. In addition to surgical excision of cancer, which is highly effective in early stages of the disease, there are now available such physical agents as the Roentgen rays and the radiation from radium which are able to destroy the cells of cancer and permit healing in many instances without surgical excision. The organization of special institutions for the care of patients with malignant neoplastic disease has made possible the development of a very high degree of skill in the selection of the proper method of treatment and in the employment of these various agencies. These are practical results of cancer research.

The American Association for Cancer Research is the organization on this continent for the fostering of all investigations regarding neoplastic disease. I deem it a privilege to extend my personal congratulations to the investigators here assembled and especially to those who are bringing to us the fruits of their arduous labors which may add much or little to our understanding of tumors. Those, like myself, who have come with empty hands, are also fortunate in the opportunity to learn the new discoveries in this field, but especially in the privilege of intimate association with those earnest research workers who are even now creating the newer knowledge of cancer.

CARTESIANISM IS BECOMING LESS A DOGMA[1]

By Professor WM. A. KEPNER

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EMERSON wrote the following lines:

> 'Tis the day of the chattel,
> Things are in the saddle,
> Web to weave, and corn to grind
> And ride mankind.

In Emerson's day, it appears, men were obsessed with the reality of things as over against life.

Things are yet in the saddle. We have so believed in matter—things—that, I fear, we have prayed too earnestly, "Give us this day our daily bread." It seems that, in this respect, we are like the good householder who had resolved to pray for a peck of everything. That night he prayed for a peck of this, a peck of that, a peck of pepper. "Oh, hell! Lord, that's too much pepper." So we find our prayers for bread answered. But hell, Lord, there's too much bread; for our storehouses are filled and our markets glutted with food; while upon all sides our neighbors are found hungry. Our conviction in the reality of bread has caused us to neglect the prayer, "Thy kingdom come." Bread, not personality, has been considered real by men and mankind finds itself in a muddle.

Science has been responsible for this situation. She has been under the sway of Cartesianism during the nineteenth century. The Cartesian revolution was launched by Descartes in the early seventeenth century. Prior to Descartes even men like Kepler and Galileo were seeking rather "divine perfection and purpose" than "sober description." The great value of this revolution lay in the fact that men were freed by it of the authority of the Aristotelian scholastics and of the symbolism that the Neo-platonists saw in numbers, the stars and celestial circumstances. Following this revolution, "Purposes gave way to mathematics, human will and foresight to immutable and inflexible mechanical order."[2] Since Descartes, amoebae have been compelled to ingest food; birds to fly because they were mere machines and youths to aspire to win maidens because of the complex concatenation of circumstances that was behind them and of the fortuitous concourse of atoms that was within them. The reaction of an amoeba, the flight of a bird and the aspirations of men were all determined by what came to be considered the result of "chemic compulsion."

Thus biologists find themselves in a peculiar position as they are confronted with the two mysteries—matter and life. Under the influence of Cartesianism they have chosen the former.

Hence they have the peculiar habit either of defining their sciences as that of life and then hastily reducing life to terms of protoplasm or of referring to it as the science of living matter. They avoid life with its implications of purpose and cooperation.

This attitude on the part of the biologists arises out of the influence of Darwinism, which brought the reign of law into the realm of life. The theory of the survival of the fittest was applied to biological processes in the most detailed manner. I was taught, for example, that I existed only because of the nicely balanced struggle, that was maintained in my body, between its cells and tissues for the necessary materials with which to maintain their respective combustions. Within living forms, there was only struggle. There could be no cooperation. Cartesianism applied to biology, therefore, put cooperation, life itself, out of the universe.

But turn where we will, where we find life there we find cooperation. In our own laboratory we frequently witness two or more amoeba-like animals fusing, as though they were droplets of fluid, in order that a large food-object might be "swallowed" and digested. After the meal has been appropriated the cooperating individuals separate.

Who of us, who saw in Dr. Speidel's film last year a phagocyte struggling until it entered the sarcolemma of a nerve and picked up and carried away a foreign particle from within the sarcolemma, was not impressed with the cooperative aspect of this conduct?

In my own laboratory some interesting observations have been made upon a simple multicellular animal known as *Stenostomum oesophagium*.

This animal possesses no female gonoducts and yet its egg is large and supplied with much yolk. This yolk is needed as food for the embryo that will develop from the egg. Since there are no yolk glands to furnish yolk, material for yolk-elaboration must be obtained in some other manner. To this end wandering cells become phagocytic and consume the "head" with its pharynx, organs of special sense and "brain." The material thus obtained by the wandering cells is carried to the growing "egg" and converted into yolk.

Similar phenomena are displayed by *Stenostomum* under other conditions. Dr. Yoe and I[3] found that

[1] Address of the retiring president of the Virginia Academy of Science.

[2] J. H. Randall, "The Making of the Modern Mind." Houghton Mifflin Co., Boston, p. 227.

[3] Wm. A. Kepner and John H. Yoe, *Jour. Exp. Zoology*, Vol. 66.

if you subject one of these animals to distilled water which lacks the necessary materials for metabolism, the simple epidermis will become stratified and the cells of the inner strata will become amoebocytes that go out into the body and consume the "head" thus supplying the body proper with material by means of which it can tide itself through the period of vicissitude, if this be not too prolonged.

Carter[4] and Hess[5] have obtained other evidence of the cooperative conduct of the amoebocytes and histiocytes of *Stenostomum*.

Finally, where would we be if it were not for cooperation on the part of the cells, tissues and organs in our own bodies? Where, for example, would I be at this moment if the tissues in my lower extremities were to refuse to do their part on the basis that their aristocratic fellows, the neural tissues, were not doing their share of work and yet were being better cared for and protected? My state would be no less unfortunate if the neural tissues of my body were to rebel on the basis that they were the important individuals in my body and would demand all the food and drink and not condescend to help the more lowly tissues. In the one case I'd collapse; in the other I'd faint. In either case this address would come to an end, and you all would be filled with a cooperative impulse to help a fellow being. In the economy of a metazoan's body there is no place for either the arrogant aristocrat or the cringing communist. All life is cooperative, and Wheeler[6] is justified in saying that "the social is a correlate of life."

Life, however, is purposive as well as cooperative. Indeed, cooperation seems to imply purposiveness.

It is because of this purposiveness that I was able to point out some years ago[7] that physicists and chemists differed from biologists in that they need only the phrase "as a result of" in referring to their facts, whereas the biologists are compelled to use the phrase "in order that."

This distinction yet holds. I was greatly impressed with the apparent scientific attitude of a recent psychobiographer who would consider all the conduct of his subject to be the result of the subject's past experience. His subject, for example, had a keen sense of right and wrong, which arose out of his experiences when his mother weaned him. As a result of having been weaned the world was no longer entirely good; there was also wrong. As a result of all this a keen sense of right and wrong had been developed in the subject's mind. Throughout the first half of the book the psychobiographer got along fairly well with the phrase "as a result of." But near the middle of the book he fell from his strictly scientific attitude; for he said, "The censor [conscience] has been built up in order to keep the ego in check."[8] This is the purposiveness that even a psychobiographer must recognize in life.

I have been told that one biologist is revising his text-book with the object of using only the phrase "as a result of" and deleting anything that may imply the phrase "in order that." To my mind this will be a difficult task; but even if accomplished it is needless. For the book is being revised *in order that* it may be ultra-scientific. A mechanistic biologist must needs show purpose, for he too lives.

An amoeba takes in food in order to satisfy a metabolic demand. There is more here than a mere chemic compulsion; for, as William James has indicated, amoebas do not fill gluttons' graves. Men struggle that ideals may be realized and not because of chemic compulsion. Jennings is justified in ascribing to biologists the guilt of the monstrous absurdity "that ideals and purposes play no part in life."[9]

Moreover, it must not be overlooked that metabolism presents a unique situation for the science of biology. Metabolism represents a flow of matter through the body of an organism. The substance thus carried into and out of the body is used in building up (anabolism) and breaking down protoplasm (katabolism), with the result that energy is made available for the work of the organism.

Matter in an organism is therefore transient. It has been estimated that there is a complete turnover of material in one's body every seven years. Hence it was a foolish Japanese who, after having lived in the United States for twenty years, had decreed that his body should be burned and the ashes sent back to dear old Japan from whence they had come. Good old American ashes had been sent back to Japan. The material of his body had been transient, but his personality had persisted during those twenty years.

Nuttycombe and I[10] have held an animal that eats another animal and appropriates the "loaded guns" (nematocysts) of its victim away from the "gun-maker" for twenty-six asexual generations. One of the more than two million potential individuals of the twenty-seventh generation ate a "gun-maker," appropriated and used its "guns." Thus through twenty-six generations of bodies matter had been streaming—had come and gone—and yet none of it had had experience with "gun-makers" and their "guns." However, the instinctive knowledge to appropriate and use the "guns" had persisted.

[4] J. S. Carter, *Jour. Exp. Zoology*, Vol. 65.
[5] Margaret Hess. In manuscript.
[6] W. M. Wheeler, SCIENCE, 64: 437.
[7] Wm. A. Kepner, SCIENCE, 73: 692, 1931.
[8] L. Pierce Clark, "Lincoln: a Psychobiography," p. 87. Scribner's, New York, 1933.
[9] H. S. Jennings, SCIENCE, 65: 24, 1927.
[10] Wm. A. Kepner and J. W. Nuttycombe. *Biol. Bul.*, Vol. 57.

In addition to this, we have been able to mutilate these animals extensively after they had been removed from "gun-makers" by fifteen or more generations. Regeneration of lost parts was followed by normal conduct toward "gun-makers" and their "guns." It is true that the individuals in all these generations represented but one gene complex; but taking cognizance of that point, the peculiar fact remains that even genes must respire and that matter, therefore, had come and gone through countless numbers of gene-generations. Matter in the case of microstomum was transient, but the manifestation of life had persisted.

In the purposive, cooperative effort of life and in its persistence throughout the metabolic flow of matter, biologists are confronted with characteristics that are peculiar.

The Cartesian dogma would ignore these characteristics of life. Many biologists yet consider that they can not afford to recognize these phenomena. To do so would jeopardize their scientific attitude.

The physicists and chemists appear to have less respect for the foundation upon which the Cartesian dogma was based. In the nineteenth century the atom was looked upon as the only form of reality. It was solid and immutable. Out of various combinations of atoms all forms of matter and phenomena arose. The physicists and chemists are becoming less dogmatic in their conception of matter and the atom as an ultimate form of reality. The concept of the atom is changing and in the case of hydrogen is considered to be nearly empty. One physicist speaks of matter as being a "derivative of consciousness." Others claim that matter may be reduced to terms of energy or electricity. Finally, no scientist is prepared to tell us what electricity, of which protons and electrons may be composed, is. One has in all this a decline of the attitude that had been assumed by scientists since Descartes.

Biologists, too, are becoming less inclined to reduce all vital phenomena to terms of matter. In the nineteenth century even mind was held to be an epiphenomenon. The brain secreted thought as the liver secreted bile. There could be no psychosis without neurosis. The regulative, cooperative conduct of an animal is now seen to involve all the tissues and cells; so that, in the case of the animal that eats "gun-makers," one is compelled to modify the phrase "no psychosis without neurosis" to run "no psychosis without epidermosis, endodermosis and mesodermosis." Or as one of my colleagues has said, "One's consciousness is realized through the cooperation of all the cells of one's body." The cells of one's toe as well as his cortical brain-cells play a part in the realization of consciousness. Wells, Huxley and Wells, in reviewing the knowledge men have of psychic phenomena, conclude that "mind and matter are two aspects of universal stuff."

Some scientists have, therefore, departed far from the idea that the atom of matter represents ultimate reality and life is no longer held to be a product of matter. Matter may be electricity. Electricity and life may be two phases of reality.

I have never seen electricity perish and I have never seen life die.

A child was watching me clean fish one day. As I went on with my work she ran on with her child's mind. The following conversation was opened by the working of her mind:

"Daddy, have these fish died and their souls gone to heaven?"

"Little Lida, do you know what electricity is?"

"Of course I do, have I not been shocked by it when I put my fingers into the outlet by the floor?"

"Do you know what life is?"

"Of course I do; am I not alive?"

"Now then, I may be in a position to answer your question concerning these fish. Can you see electricity by means of your brother's electric locomotive?"

"Yes; for if electricity is there, it runs."

"If while it runs one breaks the engine, does that destroy electricity?"

"No."

"If a mechanic repair the locomotive can you again see electricity by means of the repaired engine?"

"Yes."

"Well, the situation with reference to these fish is similar [analogous]. Life, like electricity, is everywhere. Our bodies are like machines through which we see life in one another. When these bodies break we can no longer see life, just as when an electric toy is broken we can no longer see electricity manifested. Now these fish's bodies are broken machines. Were I an expert biologist, I could repair them and then you would again see life manifested by these bodies. You may some day see my body break, but that will not necessarily mean that the life you recognize as Daddy will die. Living daddies and their daughters never die, though their bodies break and disintegrate in time."

The little girl closed our conversation with "I like dat story, Daddy."

So I close my address by reminding you that Cartesianism is becoming less a dogma. This dogma has led us to an unsatisfactory social situation, wherein the "ever-increasing beauty and power of science are manifest"; but wherein "the power of religion" has not "grown to render impossible hate and strife between races and nations"[11] and individuals.

Perhaps the next generation of biologists will look

[11] Richard Willstätter, SCIENCE, 78: 274, 1933.

upon protoplasm as the "medium of vital manifestation" rather than the physical basis of life and thus establish a better foundation upon which to build the social and personal progress of human beings. Humanity has been admonished to seek life rather than things.

OBITUARY

HENRY TITUS KOENIG

1891–1934

BORN, Pittsburgh, Pa., July 14, 1891, son of George F. and Barbara Dinkle Koenig. Graduated from Tarentum High School in 1908. Obtained B.S. degree in chemistry, University of Pittsburgh, June, 1912. From 1912 to 1914 associated with fellow classmate, the late Glenn Donald Kammer, and with the late Dr. Charles H. Viol, in laboratory of Standard Chemical Company, Pittsburgh, in pioneer work on radium recovery from carnotite ore from Colorado, resulting in a method for profitable radium recovery from this ore. In 1914–15, studied under Professor George H. Hulett at Princeton; while there, with Dr. Willy A. Schlesinger, established experimental laboratory of radioactivity. The two incorporated the Schlesinger Radium Company, which began operating in 1915. In this laboratory, in Denver, Koenig developed luminous materials which were employed by the U. S. Government during the World War. In 1919, Koenig, while on leave of absence, spent six months with Professor Herman Schlundt in the University of Missouri. He continued as chief chemist for the Schlesinger Radium Company until 1921. While there, he developed methods for increasing the radium recovery from 50 per cent. of the content of the ore to 88 per cent., thus obtaining about one gram of radium from 200 tons of handpicked ore. Then the rich ore from Katanga in the Belgian Congo was announced. Koenig was called by the Union Miniere of Oolen in Brussels, Belgium, to apply his recovery methods to the richer ore. At the same time he installed apparatus for the recovery of radium emanation, or radon. The Belgian development cut the price of radium in half and the American industry ceased. After the Belgian development, he spent about three months with Madame Curie and frequently visited Professor Aartz in Holland. In 1923, he returned to America, when his interest shifted from radium to vanadium, and in the service of the U. S. Vanadium Company in Colorado, he developed the chloride-bisulfate roasting process for vanadium recovery. He patented the process, which was commercially successful. During 1923–24, his process for forced precipitation of potassium yielded phosphorus-free ferro-vanadium. Following this, he spent four months with Professor Colin G. Fink of Columbia, and then joined Harry Payne Whitney at the Hudson Bay Mining and Milling Company. As chief chemist, he developed methods for treatment of complex sulfide ores containing gold, silver, copper and zinc and was co-patentee of the process. During this association, which lasted until 1931, plant construction involving almost twenty million dollars developed. In the fall of 1931, he opened consulting laboratories in Denver, Colorado, which he continued until his death, May 20, 1934.

Koenig made the same sacrifice as his fellow pioneers who had entered the radium recovery field—succumbed to the insidious effects of radium when only 43 years of age. He is deserving of the highest tribute for his pioneer venture into an unknown and dangerous field, and for his valuable contributions there and the other developments cited.

He is survived by his mother; a sister, Mrs. George H. Spacke, of Denver; another sister, Mrs. Louise von Warren, of San Diego, California; and a brother, Walter J. Koenig, technical director of the Sloane-Blabon Corporation of Philadelphia.

ALEXANDER SILVERMAN

RECENT DEATHS

DR. NATHANIEL LORD BRITTON, for thirty-three years, until his retirement as director emeritus in 1930, director-in-chief of the New York Botanical Garden, previously professor of botany at Columbia University, died on June 25. He was seventy-five years old.

JOHN MERTON ALDRICH, associate curator of insects in the National Museum, died in Washington, D. C., on May 27, at the age of sixty-eight years.

PROFESSOR LEONARD P. DICKINSON, head of the department of electrical engineering at the University of Vermont, died on June 3 at the age of sixty years. Before going to Vermont fourteen years ago, he had served on the faculty of Lafayette College, of Rhode Island State College and of Robert College, Constantinople.

PROFESSOR RICHARD THORNTON FISHER, director of the Harvard Forest at Petersham, Massachusetts, died suddenly on June 9, at the age of fifty-eight years.

DR. HARRIET W. BIGELOW, head of the department of astronomy at Smith College, died at Soerabaja, Java, on June 29. Miss Bigelow was sixty-four years old.

DR. JAKOB JOHANNES SEDERHOLM, director of the

Geological Survey Commission of Finland, died on June 27, at the age of seventy-one years.

THE death is announced at the age of eighty-three years of Dr. J. P. van der Stok, director of the Section of Oceanography and Maritime Meteorology at the de Bilt Meteorological Institute, near Utrecht, in 1899–1923, formerly director of the Magnetic and Meteorological Observatory, Batavia.

A CORRESPONDENT writes from Canada: "Geological and academic circles will experience a great loss in the death of Dr. Stuart Raeburn Kirk, who died in Winnipeg, Manitoba, on May 15, 1934. Dr. Kirk has been assistant-professor of geology in the University of Manitoba since 1927. During that time he served as field-officer for the Geological Survey of Canada and made some notable contributions on the stratigraphy of southwestern Manitoba. Dr. Kirk graduated from St. Andrews University, Scotland, in 1922. After securing his doctor's degree there in 1925, he studied under a Commonwealth Fund fellowship at Yale University from 1925 to 1927. Dr. Kirk had established an enviable reputation as a teacher and as a paleontologist and his death at the early age of thirty-four years is regretted in a large circle of friends and in the scientific world at large."

SCIENTIFIC EVENTS

KING GEORGE'S BIRTHDAY HONORS

THE King's birthday honors list, as recorded in *Nature,* includes the names of the following men of science and others associated with scientific work and development. *Baron:* Sir Hugo Hirst, chairman and managing director of the General Electric Company, Ltd. *G.B.E.:* Sir John Reith, director-general of the British Broadcasting Corporation. *K.B.E.:* Dr. F. G. Banting, Dominion of Canada, discoverer of insulin. *Knights:* Major R. G. Archibald, director of the Wellcome Tropical Research Laboratories, Sudan; A. W. Flux, honorary vice-president (past president) of the Royal Statistical Society; Albert Howard, lately agricultural adviser to the States in Central India and Rajputana; Dr. W. H. Moberly, vice-chancellor of the University of Manchester; Dr. C. E. Saunders, lately Dominion cerealist, Dominion of Canada, discoverer of Marquis, Ruby, Reward and Garnet Wheat; Professor G. Elliot Smith, professor of anatomy in the University of London (University College). *C.B.:* Dr. R. E. Stradling, director of Building and Road Research, Department of Scientific and Industrial Research. *C.M.G.:* A. C. Bagshawe, secretary of the Department of Agriculture and Lands, Southern Rhodesia; Professor R. S. Troup, director of the Imperial Forestry Institute and professor of forestry in the University of Oxford, for services to forestry in the Colonies. *C.I.E.:* F. Canning, chief conservator of forests, United Provinces; P. E. Aitchison, chief conservator of forests, Bombay Presidency; W. McRae, director and Imperial mycologist, Imperial Institute of Agricultural Research, Pusa. *C.B.E.:* Dr. W. L. Balls, chief botanist, Egyptian Ministry of Agriculture; L. St. L. Pendred, editor-in-chief of the *Engineer;* Dr. L. J. Spencer, keeper of minerals, British Museum (Natural History). *O.B.E.:* Dr. S. G. Barker, for research services to the Empire Marketing Board; A. D. Cotton, keeper of the Herbarium and Library, Royal Botanic Gardens, Kew; Miss E. H. Ekins, principal of Studley Horticultural and Agricultural College for Women; Miss Annie Lorrain-Smith, for contributions to mycology and lichenology; Dr. C. Raeburn, assistant director of the Geological Survey Department, Nigeria. *M.B.E.:* F. G. Harcourt, curator of the Botanical Gardens and Agricultural Superintendent, Dominica, Leeward Islands; J. D. Kennedy, sylviculturist, Nigeria. *I.S.O.:* G. E. Greig, lately senior warden of mines, Federated Malay States.

PRINCETON UNIVERSITY GEOLOGICAL EXPEDITIONS

THE department of geology of Princeton University will send out sixteen expeditions this summer to study various phases of geology in Canada, Newfoundland and parts of the United States, ranging from the Adirondacks to the mineral regions of Utah, according to an announcement made by Professor Edward Sampson.

The annual Scott Fund expedition is this year being divided into sections. One will continue research in the Big Horn Basin region in Montana. Dr. Glenn L. Jepsen and Professor William J. Sinclair will direct the division in work in vertebrate paleontology. Professor Erling Dorf will be at the head of the second section, which will examine the deposits of some of the earliest known fossil fish in the vicinity of Beartooth, Butte, Montana.

Under the leadership of Professor Benjamin F. Howell, another group will work near Denver on Cambrian faunas between there and the Red Lodge Basin region of Montana. Near Red Lodge Professor Howell will join Mr. Steven K. Fox, who will work on the Cretaceous stratigraphy of the Big Horn Basin, correlating events in Montana and Texas. Also, working in this neighborhood will be Professor William T. Thom, Jr., one of the directors of a large expedition doing general geological research in this district.

The department of geology will work with the School of Public and International Affairs of the University and the Department of Politics of the University of Toronto in conducting a summer school for undergraduates studying the relation of natural resources to political and economic problems. The school will travel in the *Princeton,* a Pullman car especially constructed for living and study quarters. Besides doing field work in many parts of the Dominion, the members will hold conferences in the principal cities of Canada. Professor Richard M. Field will have charge of the expedition and will be assisted by Professor Erling Dorf, who will return from his studies in the West in time to join the school.

Dr. Alfred K. Snelgrove, who recently has been appointed consulting geologist for the Newfoundland Government, will investigate the mineral resources of Labrador and Newfoundland. Working in cooperation with experts of the Newfoundland Government, Dr. Snelgrove will study the gold prospects in that region.

Gilbert S. Espenshade, a graduate student, will lead an expedition on the Northeast Coast of Labrador to study pyrite deposits on Pilley's Island in Notre Dame Bay. On the west coast of the island John Cooper, also a graduate student, will continue his study, begun last summer, of the Blow-Me-Down Range. George R. Heyl, another graduate student, will examine the Appalachian Mountains on the northeast coast of the island, at the point they go into the sea.

Professor Arthur F. Buddington will continue his work of the last three years in the northwest part of the Adirondacks.

In the western part of the United States Professor Sampson will study the chromite deposits of the Stillwater District of Montana. Richard Fisher, a graduate student, will make a survey of deposits of copper, silver, vanadium, uranium and radium in parts of Oklahoma, Texas, Colorado, New Mexico and Utah.

Undergraduates in the department of geology will assist the professors and graduate students in each of the expeditions.

MERGER OF THE BUREAUS OF ENTOMOLOGY AND OF PLANT QUARANTINE

Two major units of the U. S. Department of Agriculture, the Bureau of Entomology and the Bureau of Plant Quarantine, have been merged into one, to be known as the Bureau of Entomology and Plant Quarantine, according to an announcement made by Secretary of Agriculture Henry A. Wallace. The new organization takes over from the Bureau of Plant Industry the activities on the control and eradication of five important plant diseases.

This consolidation, which went into effect on July 1, will permit greater economy of administration in the search for better methods of insect pest control and in the regulatory work necessary to prevent the spread of plant pests and diseases. It also ensures better coordination and more effective direction of the various parallel lines of research and control activities.

Lee A. Strong, formerly chief of the Bureau of Plant Quarantine and since October 1 chief of the Bureau of Entomology, has been appointed chief of the new bureau. S. A. Rohwer, now assistant chief of the Bureau of Entomology, and Avery S. Hoyt, now assistant chief of the Bureau of Plant Quarantine, will be assistant chiefs. F. H. Spencer will be business manager. Dr. Karl F. Kellerman, formerly associate chief of the Bureau of Plant Industry, will have charge of the division devoted to the eradication and control of citrus canker, phony peach disease, Dutch elm disease, white pine blister rust and the stem rust of grains.

Research in the Bureau of Entomology and Plant Quarantine will cover studies on the life history and habits of beneficial as well as of injurious insects, with a view to developing practical methods for destroying injurious insects and for promoting the increase and spread of those found beneficial. The regulatory work, under the authority of the Federal Plant Quarantine Act, will include the enforcement of quarantines and restrictive measures to prevent the entry into, or the spread within, the United States of dangerous plant diseases and insect pests.

Under the new arrangement the different lines of work on related subjects, whether regulatory or research, are brought together in a single unit. The work of collection, introduction and clearing through quarantine of foreign parasites for the control of injurious insect pests has been placed in a single division under the direction of C. P. Clausen. The fundamental investigations to develop control methods by the use of insecticides, attractants and repellants have been brought together in the Division of Control Investigations, under Dr. Lon A. Hawkins. The Division of Household and Stored Product Insects, in the Bureau of Entomology, as such, has been discontinued, and the work has been assigned to other divisions. Studies on insects attacking stored products have been transferred to the divisions concerned with the insects that infest the same crops in the field. For example, investigations on dried fruit insects will be conducted by the Division of Fruit Insects. As the insects found in stored products are often hangovers from field infestations, such an arrangement is designed further to simplify and expedite the work. The investigations on household insects formerly assigned to this division have been transferred to the Division of Insects affecting Man and Animals, under the direction of Dr. F. C. Bishopp, who has long been in

charge of that division. All informational work has been brought together with the Insect Pest Survey and placed in the Division of Insect Pest Survey and Information, under the leadership of J. A. Hyslop.

The other research divisions of the Bureau of Entomology, the regulatory divisions of the Bureau of Plant Quarantine, and the field stations of both bureaus will remain about as they were.

APPOINTMENTS AT THE ROCKEFELLER INSTITUTE FOR MEDICAL RESEARCH

THE Board of Scientific Directors of The Rockefeller Institute for Medical Research announces the election of Dr. Warfield Theobald Longcope as a member of the Board of Scientific Directors to succeed Dr. William H. Welch, deceased.

The following promotions and appointments are announced:

PROMOTIONS

Associate Member to Member, Dr. Leslie T. Webster.
Associate to Associate Member, Dr. Richard E. Shope
Assistant to Associate, Dr. Francisco Duran-Reynals, Dr. Kenneth Goodner, Dr. Geoffrey W. Rake.
Fellow to Assistant, Dr. Kenneth S. Chester, Dr. Erich Traub, Dr. Philip R. White.

NEW APPOINTMENTS

Associate Member, Dr. Max Bergmann.
Assistants, Dr. Donald C. Boughton, Dr. Jack Compton, Dr. James R. Dawson, Jr., Dr. Lee E. Farr, Dr. Delavan V. Holman, Dr. John G. Kidd, Dr. Colin M. MacLeod, Mr. William F. Ross, Dr. Thomas F. M. Scott, Dr. Joseph E. Smadel, Dr. Carl V. Smythe.
Fellows, Dr. Bacon F. Chow, Mr. Joseph S. Fruton, Dr. George I. Lavin, Dr. Charles V. Seastone, Jr., Dr. William Trager.

SCIENTIFIC NOTES AND NEWS

LORD RAYLEIGH, foreign secretary of the Royal Society, and Dr. Robert A. Millikan, of the California Institute of Technology, who retired on July 1 as foreign secretary of the National Academy of Sciences, will preside over a joint meeting in London of the International Union of Pure and Applied Physics and of the British Physical Society. The conference, held in response to an invitation from the Royal Society, will meet from October 1 to 6 at the Royal Institution. A visit to the Cavendish Laboratory of the University of Cambridge will be made on October 4.

COMMEMORATING the pioneer work in antitoxin of Dr. Henry Sewall, who conducted his experiments at the University of Michigan from 1882 to 1887, the Delta chapter of Delta Omega, national public health society, held a banquet at the Michigan Union on June 6, presenting to the university a bronze plaque honoring Dr. Sewall. In 1887 Dr. Sewall published a treatise on his work in immunizing animals against snake venom. The society also plans to publish a pamphlet containing a photostatic copy of the original treatise.

DR. EDWIN B. FRED, professor of bacteriology at the University of Wisconsin, has been appointed dean of the graduate school. He will succeed Professor Charles S. Slichter, who has been dean since 1920. Dean Slichter retired on July 1, having reached the age of seventy years. He has been appointed research adviser to the Graduate School and professor emeritus of mathematics.

Industrial and Engineering Chemistry states that Charles L. Reese, president of the American Chemical Society, has received the honorary degree of doctor of science from Wake Forest College, North Carolina. At the Johns Hopkins University he was made recently a member of the honorary chemical society, Phi Lambda Upsilon, and the University of Virginia Chapter of Sigma Xi recently presented him with its key.

DR. CHARLES H. HERTY, director of the Division of Pulp and Paper Research of the Georgia Department of Forestry, has been awarded the Herty Medal of the Georgia Section of the American Chemical Society.

MEDALS for "eminent service" were presented at commencement by Amherst College to Arthur J. Hopkins, '85, retiring professor of chemistry, and to Eugene S. Wilson, of New York, vice-president of the American Telephone and Telegraph Company.

AT the commencement exercises at Michigan State College on June 11, the honorary degree of doctor of science was conferred upon James Henry Kimball, of the U. S. Weather Bureau, New York City, in recognition of his contributions to science in the field of oceanic meteorology.

OKLAHOMA CITY UNIVERSITY conferred on June 1 the honorary degree of doctor of laws upon Charles Newton Gould, formerly director of the Oklahoma Geological Survey.

AT its seventy-seventh annual commencement on June 11, Mills College conferred the honorary degree of doctor of laws upon Dr. Clelia D. Mosher, emeritus professor of personal hygiene at Stanford University.

PROFESSOR A. C. SEWARD, professor of botany at the University of Cambridge, has been elected a foreign member of the Royal Swedish Academy of Sciences.

GEORGE D. PRATT, formerly conservation commissioner of New York State, has resigned as president of the American Forestry Association. Dr. Henry S. Graves, dean of the Yale Forest School and formerly chief forester of the United States, will serve as president until the end of the year.

DR. HIRAM S. LUKENS, of the University of Pennsylvania, was elected president at the recent annual meeting of the Electrochemical Society, which was held at Asheville, N. C.

THE title of emeritus professor has been conferred on Professor Edward Mellanby, formerly professor of pharmacology in the University of Sheffield, now secretary of the Medical Research Council.

PROFESSOR GREGORY BREIT, of New York University, has been appointed professor of theoretical physics at the University of Wisconsin.

DR. T. SMITH TAYLOR, who for the last nine years has had charge of the Physical Laboratory of the Bakelite Corporation at Bloomfield, New Jersey, was recently appointed head of the department of physics at Washington and Jefferson College, Washington, Pa.

DR. JOSEPH S. CHAMBERLAIN, head of the department of chemistry at the Massachusetts State College at Amherst, has been made Goessmann professor of chemistry in recognition of twenty-five years service as professor of organic and agricultural chemistry at the college.

R. O. STREET, senior lecturer in applied mathematics at the University of Liverpool, has been appointed professor of mathematics in the Royal Technical College, Glasgow.

PROFESSOR MAX NEUBURGER, having reached the age of sixty-five years, is retiring from the chair of medical history in the University of Vienna. He will continue his directorship of the Medico-Historical Institute.

H. P. BARSS, specialist in plant physiology and pathology in the Office of Experiment Stations, U. S. Department of Agriculture, formerly principal pathologist at the Oregon Agricultural Experiment Station, has been appointed a member of the National Research Council in the Division of Biology and Agriculture. Mr. Barss was nominated by the American Phytopathological Society and the Society of American Bacteriologists.

DR. H. W. BROWN, of Vanderbilt University Medical School, has been granted a fellowship for the study of public health by the General Education Board. He will sail in August to spend a year at the London School of Hygiene and Tropical Medicine.

EDGAR B. HOWARD, research associate in the department of vertebrate zoology at the Academy of Natural Sciences of Philadelphia, has been appointed a research associate of the Carnegie Institution of Washington.

Nature records the appointment of Dr. P. L. Mercanton, professor of meteorology and geophysics in the University of Lausanne, as director of the Central Meteorological Station of the Swiss Federal Meteorological Commission, in succession to Dr. J. Maurer, who retired recently.

DR. JOSEPH PEARSON, who recently resigned his post as director of the Colombo Museum and as marine biologist to the Ceylon government, has been appointed director of the Tasmanian Museum, Hobart.

DR. ERNST WEGNER has been appointed director of the newly established State Academy for Racial and Health Welfare, opened at Dresden on April 14.

DEAN SAMUEL N. SPRING, Professors Nelson C. Brown, Edward F. McCarthy and Dr. Joseph S. Illick, of the New York State College of Forestry, were recently appointed to serve on the Forestry Committee of the New York State Planning Board. The other members of the committee are Assemblyman Ellis W. Bentley, Senator Charles J. Hewitt, Professor Ralph S. Hosmer, of Cornell University; Dr. Thomas LaMont, of Cornell University, and Assemblyman Joseph D. Nunan.

A CONGRESS of the International Society of Geographical Pathology (which was founded in 1927 by Askanazy, supported by Aschoff) will be held at Utrecht from July 26 to 28.

SIGMA PI SIGMA, honorary physics fraternity, recently installed its twenty-seventh and twenty-eighth chapters at the Oregon State College and at the University of Denver. Dr. C. L. Utterback, of the department of physics at the University of Washington, was the installing officer for the Alpha-Gamma Chapter installation at Oregon State College on May 19. At the same time Dr. A. A. Knowlton, of Reed College, was initiated as an honorary member of the society. The executive secretary, Dr. Marsh W. White, of the Pennsylvania State College, installed the Alpha-Delta Chapter at the University of Denver on May 28, assisted by Dr. W. B. Pietenpol, professor of physics at the University of Colorado.

APPLICATIONS for the position of associate veterinarian (diseases affecting wild animal life), Bureau of Biological Survey, Department of Agriculture, must be on file with the U. S. Civil Service Commission at Washington, D. C., not later than July 23. The entrance salary is $3,200 a year, subject to a deduction of not to exceed 5 per cent. during the

fiscal year ending June 30, 1935, as a measure of economy, and also to a deduction of 3½ per cent. toward a retirement annuity. Competitors will not be required to report for a written examination, but will be rated on their education and experience and on a thesis or published writings. A requirement is not less than three years of responsible professional experience, at least one year of which must have been in the treatment of, or research in, the diseases of native wild animal life.

BY the will of the late Joy Morton a trust fund of $300,000 is established, the income of which is to be used for maintenance of the 419-acre Morton Arboretum at Lisle, Ill.

THE General Education Board of the Rockefeller Foundation has made a grant of $70,000 to Bennington College, Vt.

A GRADUATE fellowship for research study in some field of metallurgy connected with aluminum has been established at the Carnegie Institute of Technology by the Aluminum Company of America. The fellowship, which is to run for two years, will be awarded to a graduate student to be selected by Dr. R. F. Mehl, director of the metals research laboratory, under whose guidance the study will be made. The grant, which becomes effective on September 1, will make it possible for the recipient to devote his full time to an investigation of a problem to be assigned by the institute. The fellow will conduct his studies in the metals research laboratory where fundamental research in metals is being done at the present time by a group of experts.

THE Rajah of Sarawak, Sir Charles Brooke, has given £20,000 towards the building scheme of the Imperial Forestry Institute at the University of Oxford, which is to be established on a permanent and self-supporting basis.

Nature reports that the Council of the Institution of Electrical Engineers has made the following awards of premiums for papers read during the session 1933–34, or accepted for publication: Institution premium to W. Kidd and J. L. Carr; Ayrton premium to B. A. G. Churcher, A. J. King and H. Davies; Fahie premium to T. S. Skillman; John Hopkinson premium to Dr. W. G. Thompson; Kelvin premium to B. L. Goodlet; Paris premium to Dr. J. L. Miller and J. E. L. Robinson; Webber premium to G. Shearing; Overseas premium to S. P. Chakravarti; extra premiums to Dr. M. A. B. Brazier, Capt. B. S. Cohen, C. W. Marshall, P. D. Morgan, W. G. Radley and Dr. S. Whitehead, H. Rissik. *Wireless Section Premiums:* Duddell premium to T. Walmsley; Extra premiums to L. H. Bedford and O. S. Puckle; E. B. Moullin, and H. D. M. Ellis; A. H. Reeves. *Meter and Instrument Section Premiums:* Silvanus Thompson premium to Dr. A. H. M. Arnold; extra premiums to J. B. Lees, Dr. E. Mallett, G. F. Shotter. *Willans Premium,* for a paper dealing with the utilization or transformation of energy: Mr. D. B. Hoseason for his paper on "The Cooling of Electrical Machines."

AN Associated Press dispatch reports that Pope Pius has signed a contract for installation of an astronomical observatory at Castel Gandolfo, the papal summer residence. This will complement the observatory in the Vatican. The contract calls for a double telescope, consisting of an astrograph with quadruple objective of 40 centimeters opening and 200 centimeters of focal distance, combined with a reflector with 60 centimeters opening and 240 centimeters focal distance. In addition, the observatory will be furnished with modern auxiliary instruments, including two large objective prisms, an astrospectrograph and a spectrophotometer register. To the observatory will be annexed an astrophysical laboratory for special researches. The new observatory will continue the specialized observations made by the late American Jesuit Father Hagen, who occupied for many years the post of Vatican astronomer. Castel Gandolfo is thirteen miles from Rome on Lake Albano.

ACCORDING to the London *Times,* in the annual report of the director of the British Meteorological Office for the year ended March 31, it is stated that during the latter part of the year messages transmitted from Horta, in the Azores, three times a day had been received fairly regularly. These messages contain a number of observations from ships in the Atlantic which have frequently proved to be of considerable importance and utility. During the year it was learned that Russia was broadcasting a synoptic message each morning containing observations made at 0100 local mean time. These reports are now regularly received and plotted on the weather map containing 0100 G.M.T. observations. Reception of the international synoptic of messages issued from Paris, Hamburg and Moscow, which were referred to in detail last year, has continued to be on the whole satisfactory. Reception from America has been less good, but considering the long range of transmission it was quite as satisfactory as could be fairly expected. Success has attended the reorganization of the work of the Forecast Division, by which the whole of the weather forecasting, whether for aviation, shipping or the general public, was last year transferred to this division. As expected, it has been necessary to retain two types of working charts, one, which is mainly used for general forecasts, taking in a large area, and one of a smaller area on a larger scale on which more detailed information can be entered for aviation. The former of the two working charts has

been increased in size so that the area of the map now includes a portion of Labrador and of Newfoundland and extends from the American coast in the west to beyond the Ural Mountains in the east. The report also contains much useful information with regard to climatology, observatories, the second international polar year, and international cooperation. In the British Isles 344 stations provided climatological data, while rainfall records were received from 5,329 stations. During 1932 there were 244 earthquakes recorded at Kew, and in eight cases the azimuth of the epicenter could be determined.

Nature, quoting from *Current Science*, states that at a joint session of the Sections of Botany and Zoology of the Indian Science Congress recently held at Patna, under the presidency of Professor Gopala Aiyer, the desirability of establishing a marine biological station in India was discussed. Colonel Sewell opened the discussion. It was suggested that the authorities of the congress should appropriate a certain sum of money which would act as a nucleus for private subscription. The general opinion was in favor of the station being at Bombay, which with its central position and varied coast line offers an ideal site for such a laboratory. It was moved and seconded that a committee of five biologists be appointed to go into the question of establishing a marine biological station in India and the resolution was carried by a large majority. The committee was constituted as follows: Dr. S. B. Setna, of Bombay (convener); Professor Gopala Aiyer, of Madras; Professor George Mathai, of Lahore; Professor R. H. Dastur, of Bombay, and Dr. S. K. Mukerji, of Lucknow.

ACCORDING to *Nature*, Professor A. F. Joffe, of the Physico-Technical Institute of the U.S.S.R., is sending out a scientific expedition to Erivan to establish a laboratory for the study of the cosmic rays. It is proposed to set up the station on Mount Alagöz, in Armenia, at a height of 14,400 feet above sea-level. The object of this station will be to investigate the distribution of the cosmic rays. The leader of the expedition is Dr. D. V. Skobeltzin. It has also been decided to set up on the shore of Lake Gokcha (6,345 feet above sea-level) an astrophysical observatory where a 16-inch reflector will be erected.

DISCUSSION

A MICROORGANISM CARRIED BY THE DUST-STORM

THE pronounced dust-storm which swept the country on May 10 brought to the laboratory a liberal supply of microorganisms.

Its thick haze hung like a fog over tremendous areas the entire day and, in addition, the windblown particles permeated the air of the buildings and interfered to some extent with respiration. While the storm was in progress the students, in the routine of the work in medical bacteriology, had occasion to examine their serial dilutions of several of the slow-growing pathogens. The agar medium had been inoculated the previous day and poured into Petri dishes. To facilitate the inspection of the colonies the covers of the dishes were temporarily removed, thus exposing the surfaces of the nutrient material to the dust-ladened air. Due to the fact that the desired cultures had not developed, the plates were returned later in the afternoon to the hot room, and incubation was continued for another 24 hours. In this manner a total of 120 individuals working in 6 separate rooms opened an average of 5 plates for intervals of less than 2 minutes each.

The following day on examining the dishes several (3–5) glistening, raised, brownish mucoid colonies ranging in size from 6–10 mm were observed on practically every agar surface. This type of growth is not ordinarily encountered by the students in this laboratory. Suspensions were made in water of material taken from a number of the colonies and examined microscopically. In each specimen large, heavily encapsulated slightly motile bacilli were noted.

The organisms in pure culture, isolated by the routine-plating methods, were uniformly shaped rods with rounded ends measuring 1.25 to 2 μ by 4 to 8 μ arranged usually in threads or chains. The thick capsules originally noted were not present in the subcultures. The motility was of a slow creeping variety. Median oval spores without enlargement of the cells were freely abundant in 36 to 48 hours on plain agar. The young cells stained regularly and were Gram positive. The protoplasm was converted into globular highly refractive bodies on sugar-containing mediums.

The colonies on gelatin plates were round with concentric rings of growth. The medium was liquefied rapidly. In the gelatin stab a sacchate zone appeared, followed in some instances after several days by a thin surface film. There was no immediate change in litmus milk, but a gradual peptonization took place with the production of a wine-red color. Dextrose, lactose and saccharose broth were not fermented; there was a rich granular sedimenting growth with no scum formation. On Russell's, Kligler's, Endo's and litmus lactose agar mediums, no change was recorded.

The general morphologic, cultural and biochemical attributes of the contaminant, when compared with authentic strains, indicated that it was *B. megatherium*, a common non-pathogenic spore-forming aerobic bacillus. It is ordinarily stated that this species is a normal contaminator, but such a conclusion does not hold as regards this laboratory, certainly not to the extent noted. The germs were unquestionably storm-borne.

In order to determine the form in which the organisms were transported, several portions of dust were collected from the tops of the desks in one of the laboratories which had not been in use on the day of the storm. One specimen was mixed with water and examined directly under the microscope. The results, however, were quite unsatisfactory. Another sample weighing about 1 g was suspended in 5 cc of physiological saline and heated at 60° C. for 1 hour to kill vegetative cells if present. Nutrient agar surfaces were subsequently streaked with the suspension, and after incubation colonies identical with the ones originally observed appeared in large numbers. Naturally other varieties of microbic life were present, but no attempt was made to identify the total flora.

It is, therefore, assumed that the organisms in the spore state were swept up by the wind with the dust particles and were transported mechanically for great distances in the upper atmosphere.

It would be interesting to know whether or not this species predominates in the native soil of Nebraska and South Dakota, the alleged origin of the dust particles.

M. H. SOULE

HYGIENIC LABORATORY
UNIVERSITY OF MICHIGAN

CAMBRIAN GRAPTOLITES

THE writer has in Bulletin No. 3, Vol. 12 (1933) of the Public Museum of the City of Milwaukee published an account of the Cambrian graptolites as far as they are known. All are Dendroidea. As this is the first time that Cambrian graptolites have been reported from various regions of America (Lower Canada, Vermont, Wisconsin and Minnesota, Tennessee and Dakota) it is of great importance that the record should be correct and no errors introduced into this new field. However, as the paper was several years in printing, some determinations have meanwhile been changed and also some labels have been found to have been misleading.

It is now known that all these graptolites are from the Upper Cambrian only and no Middle or Lower Cambrian graptolites occur. *Dictyonema schucherti* was described as coming from the Lower Cambrian of Vermont (top of Colchester formation) and thus regarded as the oldest graptolite known. Professor B. F. Howell has since found that the form comes from an Upper Cambrian horizon (Russell slate formation). Likewise *Dendrograptus edwardsi major* and *Callograptus antiquus*, which are described as coming from the Elbrook formation of Tennessee, which is Middle Cambrian, according to Dr. Chas. E. Resser, were obtained in the Nolichucky shale, which is latest Upper Cambrian. Dr. Resser also informs me that the form which he collected in an unnamed Upper Cambrian formation on the "North side of the Shoshone Canyon, just above bridge, west of Cody, Wyoming" and which I described and figured as *Dictyonema cf. minnesotense* on pp. 322–323 (*op. cit.*) may now be cited as coming from the "Deadwood series," equivalent to the Upper Cambrian. As it is a new species, distinguishable from *Dictyonema minnesotense* by the more rapid bifurcation, it may be known as *Dictyonema wyomingense*.

As the bulletin on the Cambrian graptolites had been already widely distributed by the Milwaukee Museum before I became aware of the necessary changes in age determinations, the students interested in these faunas are asked to make the changes indicated above in their copies.

RUDOLF RUEDEMANN
NEW YORK STATE MUSEUM, ALBANY

THE MECHANISM OF METHYLENE BLUE ACTION ON BLOOD

THE mechanism of the action of methylene blue as a catalytic agent in CN and CO poisoning[1] has been questioned by various writers.

Wendel[2] claims that in CN poisoning the dye changes hemoglobin to methemoglobin in the blood-stream, that this unites with CN to form a stable compound and that in this way CN is taken out of the blood stream. Henderson[3] and Haggard and Greenberg[4] claim the same action for methylene blue and conclude from this that if, as they suppose, the dye inactivates a certain per cent. of the hemoglobin by forming methemoglobin, its use in CO poisoning is a hindrance rather than an aid to recovery.

Haggard and Greenberg[4] have made experiments on dogs in which the oxygen capacity of blood containing methylene blue was determined, according to the Van Slyke-Hiller method. They found from 8 to 12 per cent. reduction of oxygen capacity, which is supposed to indicate that this proportion of the oxy-hemoglobin is transformed to methemoglobin.

The writer has, however, shown by experiments on

[1] M. M. Brooks, *Proc. Soc. Exp. Biol. Med.*, 29: 1228, 1932; 30: 493, 1933. *Amer. Jour. Physiol.*, 102: 145, 1932; 104: 139, 1933.

[2] W. B. Wendel, *Jour. Amer. Med. Assoc.*, 100: 1054, 1933.

[3] Y. Henderson, SCIENCE, 78: 408, 1933.

[4] H. W. Haggard and L. A. Greenberg, *Jour. Amer. Med. Assoc.*, 100: 2001, 1933.

rat, rabbit and dog that these investigators neglected to consider one important difference between experiments done with methylene blue *in vivo* and *in vitro*, namely, the *presence of a constant supply of glucose in vivo* as compared with the strictly limited amount available in experiments *in vitro*. When methylene blue in doses equivalent to the clinical dose was injected into animals and samples of blood taken at intervals from 15 minutes to 24 hours later and analyzed by the spectrophotometer, no methemoglobin was found. The ratio $\varepsilon_{540\ m\mu}/\varepsilon_{560\ m\mu} = R$ was found to be 1.63, indicating, according to Ray, Blair and Thomas,[5] that only oxyhemoglobin was present. This method requires but a few minutes for an accurate determination and is capable of detecting less than 2 per cent. methemoglobin in oxyhemoglobin.

The same conclusions have been reached by Williams and Challis[6] and Geiger,[7] using spectrographs of the blood of human cases. These conclusions have, however, been doubted because of the insensitivity of the method, the minimum surely detectable proportion of methemoglobin being about 25 per cent.

The explanation is quite simple. Warburg, Kubowitz and Christian[8] have shown that there is no appreciable amount of methemoglobin formed when methylene blue is added to red blood cells *in vitro* in the presence of an adequate amount of glucose, because the cycle hemoglobin $\rightleftarrows$ methemoglobin is continuous as long as the supply of glucose remains. Since methylene blue is a reversible oxidation-reduction indicator, this process of forming methemoglobin, which in turn is reduced by glucose to hemoglobin and again reoxidized by methylene blue, goes on in a continuous cycle. This is what takes place *in vivo*. When only a small amount of glucose is present, it is quickly used up in the presence of methylene blue and then methemoglobin heaps up. This is the condition under which the writers quoted have worked.

When nitrite is added to hemoglobin a stoichiometric equivalent of methemoglobin is formed which when once reduced by glucose is not reformed. This differs from the action of a catalyst such as methylene blue.

Therefore the above-mentioned writers have made their objection to the use of methylene blue in CN and CO poisoning on a false basis; for the demonstrated absence of methemoglobin in the blood after methylene blue therapy is conclusive disproof of their indirectly arrived at results.

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[5] G. B. Ray, H. A. Blair and C. I. Thomas, *Jour. Biol. Chem.*, 98: 63, 1932.
[6] J. R. Williams and F. E. Challis, *Jour. Lab. and Clin. Med.*, 19: 166, 1933.
[7] J. C. Geiger, *Jour. Amer. Med. Assoc.*, 101: 269, 1933.
[8] O. F. Warburg, Kubowitz and W. Christian, *Biochem. Zeit.*, 227: 245, 1930.

THE TIME CONSTANT

"THE Time Constant" was the title of a discussion which appeared in SCIENCE for May 25 (page 479), having been communicated by Professor Joseph O. Thompson, of Amherst College. In it Professor Thompson called attention to the fact that if the rate of increase

$$\frac{di}{dt} = \frac{r}{l} i_o$$

in the current strength "should be maintained for l/r seconds the current would reach its final value i_o. This ratio l/r, generally called the time constant, is therefore numerically equal to the number of seconds required for the current in reaching its final value if the initial rate of rise should be maintained."

While agreeing with Professor Thompson that this way of regarding the time constant appears to be unusual, the writer has thus regarded it for many years and demonstrated it on pages 245 and 246 of his book "Magnets," published in 1924. The book also contains calculated tables, originally published by the writer in *Electrical World* (Vol. 78, p. 872, 1921), by means of which numerous examples, showing the quantity of electricity displaced, the amount of magnetic energy stored, the amount of energy stored in dielectrics and as heat in coils or resistors, in various circuits and during any time interval, are worked out easily and quickly by simple algebra.

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A FORGOTTEN TREE RING RECORD

THE intensive study of tree rings in timbers from ruins in our Southwest is known favorably to all archeologists. Dr. A. E. Douglass, considered the authority in tree ring studies, through his labors and those of other archeologists has been able to date accurately many of the Pueblo sites.

I think it is no more than fair to bring to the attention of readers that as far as I can ascertain the first mention of tree ring study occurred in my book, "Fort Ancient," published at Cincinnati in 1890. This volume is devoted to a survey and description of Fort Ancient by the late Mr. Gerard Fowke, a competent authority, Mr. Clinton Cowen, an engineer, and myself. On page 34 of that book is presented the result of tree ring counting on a large walnut stump located in the southern part of Fort Ancient. This tree was famous in that part of the country because of its size. It had been cut nineteen years before the survey. The lower part of the stump was fairly well preserved. At the suggestion of a botanist, our men sawed the stump close to the ground, and Cowen

and Fowke carefully counted the rings. The total was 255 years. Thus we found that the tree sprouted in 1615.

A stone grave was found under this stump, and the tree roots extended over and down upon all sides. How many years previous to the growing of the sapling the burial was made, no man may know.

It is fortunate this record was set down at the time of our exploration.

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QUOTATIONS

A FAMILY OF DOCTORS

DR. WILLIAM HENRY WELCH, the illustrious pathologist, was laid to rest last May in the "buryal-yard" of the Connecticut village where he was born. An article by Dr. Harvey Cushing on "The Doctors Welch of Norfolk," reprinted from *The New England Journal of Medicine*, has just appeared in pamphlet form. The author's sense of atmosphere and form, the restraint and delicacy of his literary art, may stir professional writers to envy or humility. He makes the reader want to go to unspoiled Norfolk, to its village green, rich in stately trees. People fortunate enough to live there stay long. In two years the average age of six persons who died was 93. In comparison the Welches are cut off in the flower of youth, in their early eighties.

Hopestill Welch, William Henry's great-grandfather, came to Norfolk in 1772. In three generations there were "at least ten Doctors Welch." As was not uncommon in New England, the profession was hereditary. "Ask the aged apothecary in the village which of the Doctors Welch was the more celebrated, he would certainly say William Wickham, the father of this William Henry." Ask him why, he would probably reply:

"If you don't believe me, just ask any middle-aged person you may chance to meet up with for thirty miles around, and see if they don't agree. Most of 'em will remember when they used to put a light in the window for him should be happen by in the dead of night. He was never known to send out any bills —pretended to forget that people owed him money— and those who paid had to press it on him."

This is a type that lingers in old Yankee memories. The Doctor was the son of a doctor, sometimes the son-in-law of a doctor. Cheerful, indulgent, wise, a good diagnostician, familiar with heredity before it was talked about, he was a sage, a friend, often a "character." He might be highly skilful, even if his medical science was antiquated. Thus of Benjamin Welch, Jr., Yale M.D., 1823, who practiced for fifty-four years, it was said in reference to his expertness as a surgeon: "Don't give up hope before you've sent for Dr. Benjamin." There is a tablet to William Henry on William Wickham Welch's house, where he was born. The drinking fountain in front, built in memory of the father, bears the inscription so singularly prophesying the son: "Fons sum solati talis et ipse fuit."

Obscure or famous, here was a tribe of bringers of relief to men. It is good to think of the world-renowned physician sleeping among his fathers in the burying ground on the old Canaan road, "in the shadow and solitude of great trees."—*The New York Times.*

SCIENTIFIC APPARATUS AND LABORATORY METHODS

A HEAD CLAMP FOR OPERATIONS ON CATS

THE head clamp here described, modified from one originally designed by Dr. Dusser de Barenne, has proved very efficient in a large number of operations on cats. It consists of four vertical bars, A, B, C, D, six transverse bars, E, F, G, H, I, J, and six screws, K, L, M, N, O, P. The height of the clamp from E to J is 5 inches; the width from A to D is 2¾ inches.

The vertical bars A and D are threaded; B and C are not. All four are firmly fixed into the transverse pieces E and J. Bar J is extended laterally into two prongs. Bar G is fixed; F, H and I are movable, and slide on the smooth uprights B and C. The ends of the movable pieces are made U-shaped, so as to fit half around the threaded uprights A and D without touching them. They can be retained in any desired position by the screws K, L, M, N, O, P. Screws M and N are thinner than the others to permit of close approximation of G and H.

In use, G and H are set close together; F and I are separated some distance from them. G and H are inserted into the anesthetized animal's mouth behind the canine teeth. They are then separated a small amount by screwing down M and N. This keeps the mouth open, through which the animal breathes, and through which ether may be administered. Bar F is screwed down on the nose by K and L; bar I is screwed up under the lower jaw by O and P. The

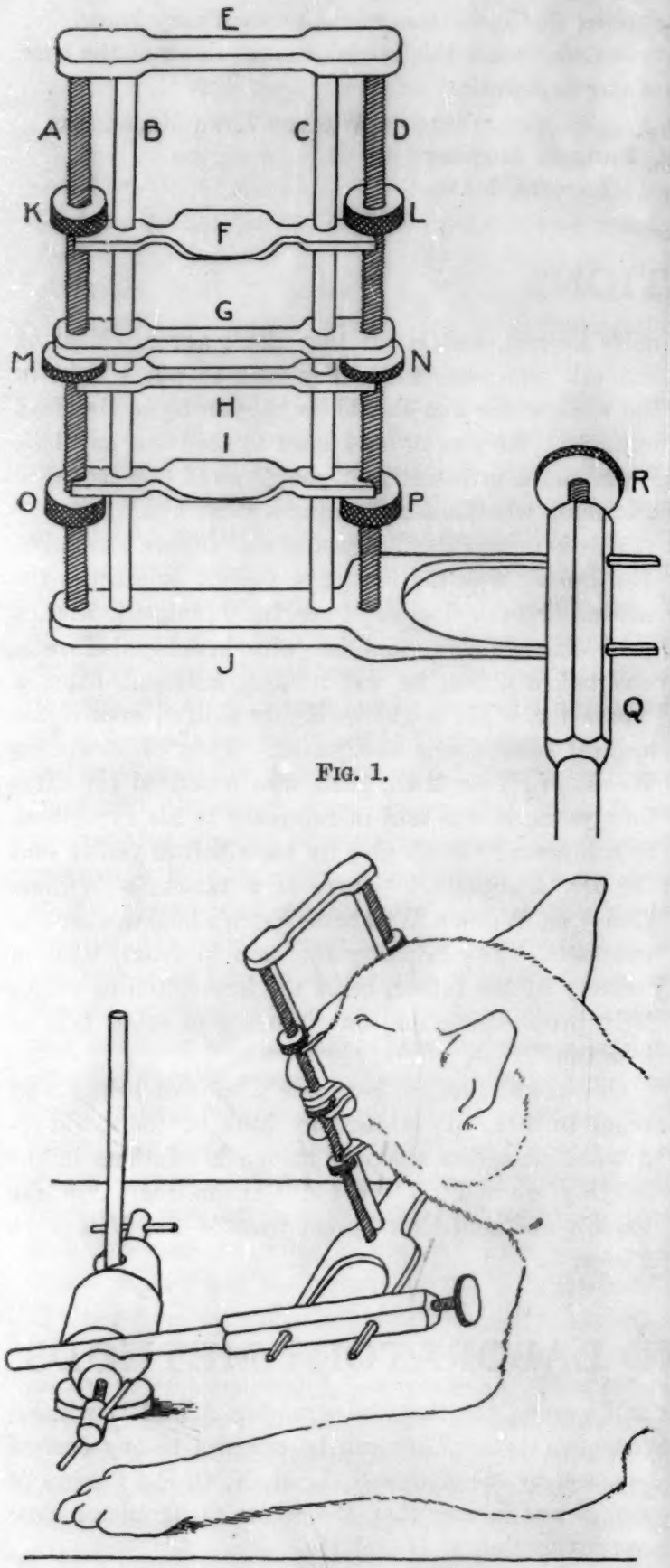

FIG. 1.

FIG. 2.

clamp thus fixed on the animal's head is inserted into the rod Q and fastened tightly by the screw R. Q is then attached to an upright rod, which is part of the operating table, by means of a universal clamp shown in Fig. 2. This clamp enables the head to be tilted to any desired angle. The figures show the instrument set up for operation on the dorsum of the head and back. It can, however, be reversed for operations on the ventral surface.

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A SIMPLE METHOD FOR INCREASING THE AMPLIFICATION OF THE MAREY TAMBOUR

ONE of the greatest difficulties in making a record of the carotid or jugular pulse is in obtaining enough amplification. The device suggested in this paper makes it possible to increase the amplification five times as much as that obtained by use of the stock Marey Tambour. Also, by counter balancing the system of levers, increased sensitivity is obtained.

The following is a drawing of the device which we

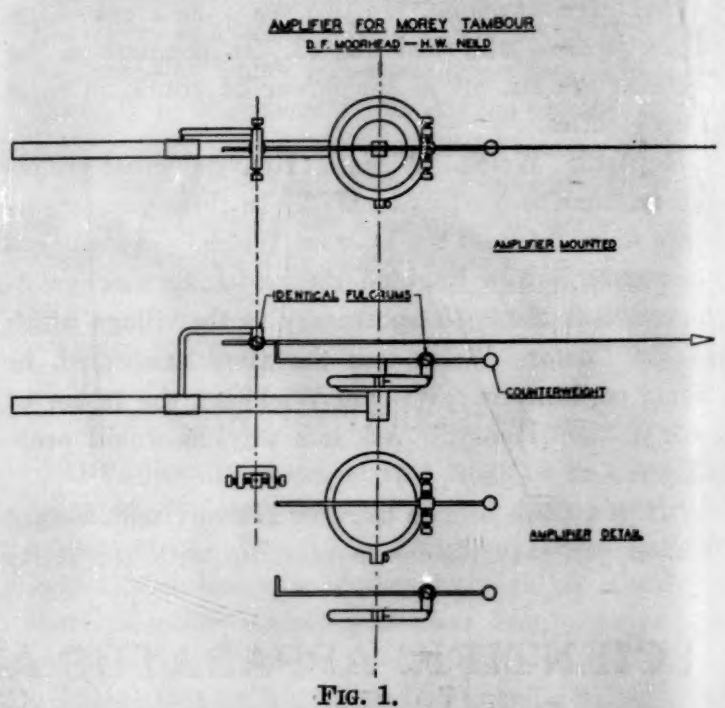

FIG. 1.

have found very satisfactory in situations that require great amplification and increased sensitivity.

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SPECIAL ARTICLES

THE PROBLEM OF STIMULATION DEAFNESS AS STUDIED BY AUDITORY NERVE TECHNIQUE

THE chief method of investigation of stimulation deafness has consisted in the histological examination of the cochlea following prolonged stimulation of the ear by sound. Results obtained by this method have been inconclusive, due both to inconsistencies in the findings of different investigators and to the fact that

histological changes within the cochlea are not necessarily indicative of a loss of hearing.

A second, more direct method consists of the study of auditory responses both before and after prolonged exposure to sound. A few investigators have incorporated this method with histological studies, but they have determined sensitivity only by such crude means as the pinna reflex or general bodily movements. Recently, however, development of the conditioned response technique has provided a more reliable means of determining sensitivity in animals.[1] The conditioned response technique is now being used in a study of stimulation deafness by one of the writers.[2]

A third method approaches the problem through a study of auditory nerve responses. The electrical effects obtained from the auditory nerve are investigated to determine whether they are significantly affected by prolonged stimulation. This method has been used by the writers in the preliminary study here reported.

Three young cats were stimulated, the first with a Galton whistle tone of 3,350~/sec. maintained 15 hours each day for 10 days (150 hours), the second with the same tone 15 hours daily for 25 days (375 hours), and the third with a tone of 980~/sec. continuously for 45 days (1,080 hours). The intensities of the tones were not measured, but we estimate them as about 80 to 90 decibels above the human threshold. At the end of the stimulation period, the animals were prepared and tested by the auditory nerve method.[3] In these tests no attempt was made to distinguish between electrical effects from the nerve fibers and from the sensory or nervous cells of the cochlea, for previous investigations have indicated that both effects reveal the essential activity of the end-organ.[4] Various tones were used in the tests, with especially careful exploration of the region of the stimulating frequency.

The results showed no significant variation from those obtained with control animals. In one experimental animal (the third) a depression of sensitivity to the amount of 6 decibels was found, extending from 745~/sec. to 765~/sec., but, since this region is remote from the stimulating tone of 980~/sec., we attach no significance to its presence, so far as the present experiment is concerned. Regional depressions of sensitivity are not unusual in the general run of animals, and even tonal gaps are sometimes encountered.[5]

Conclusions from so few results as these must necessarily be tentative. The absence of any noticeable depression of response at the stimulating frequency argues against any specific effect of the stimulation. On the basis of the majority of histological studies of this problem one would expect depression of responses in the general region of the stimulating frequency, but no such effect was observed. We are not able to state that no effect at all occurred as a result of the stimulation, for a general depression involving all frequencies to a relatively small extent, say 5 decibels or so, might not have been observable under our conditions.

The above results, tentative though they are, provide a basis for questioning the inferences for auditory theory that have been drawn from the histological studies and emphasize the need of further investigation. To solve the problems in this field, the three methods described above should be combined, with tests of auditory sensitivity before and after stimulation, followed by a study of auditory nerve responses, and finally by histological examination of the cochleas. A study of this kind has been going on for some time and will be reported soon.

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[1] M. Upton, "The Auditory Sensitivity of Guinea Pigs," *Amer. Jour. Psychol.*, 41: 412–421, 1929; G. P. Horton, "A Quantitative Study of Hearing in the Guinea Pig (Cavia Cobaya)," *Jour. Comp. Psychol.*, 15: 59–73, 1933.

[2] G. P. Horton, "Preliminary Report on the Study of the Effect of Prolonged Sound Stimulation on the Auditory Sensitivity of the Guinea Pig," *Psychol. Bull.*, 30: 548, 1933. See also M. Upton, "Functional Disturbances of Hearing in Guinea Pigs after Long Exposure to an Intense Tone," *Jour. General Psychol.*, 2: 397–412, 1929.

[3] E. G. Wever and C. W. Bray, "The Nature of Acoustic Response," *Jour. Exper. Psychol.*, 13: 373–387, 1930.

[4] E. D. Adrian, D. W. Bronk and G. Phillips, "The Nervous Origin of the Wever and Bray Effect," *Jour. Physiol.*, 73: 2P–3P, 1931; G. Finch, E. A. Culler and E. S. Girden, "Relation of the Wever-Bray Effect to Auditory Acuity in Dogs," *Psychol. Bull.*, 30: 581, 1933.

[5] See Horton, cited in note 1.

IS THE HIGH BASAL METABOLIC RATE IN "HYPERTHYROIDISM" DUE TO THYROXINE?

THE most abundant source of an internal secretion has been the gland producing it, although in the case of insulin and cortin post-mortem changes cause a loss. *Thyroxine has never been isolated from any other part of the body except the thyroid,* and Prescott (Thesis, Minnesota, 1931) has shown that all the detectable thyroxine is in the *thyroglobulin.* Notwithstanding these facts, the thyroids of persons who have been universally called "hyperthyroid" or by some name in which hyperthyroidism was implied may be shown to be very poor in thyroxine. The basis of this assumption of hyperthyroidism in these persons has been their high basal metabolic rate, but Rice and Cavett read a paper on "The Effect of Feeding Thy-

roid on Basal Metabolic Rate and Pulse Rate of Hyperthyroid Individuals" before the Society of Experimental Biology and Medicine on May 16, in which they reported that the administration of 2 grains of thyroid a day to persons with "hyperthyroidism" lowered their basal metabolic rates. In this connection the following data may be of interest.

Five persons with "hyperthyroidism" were given 190 mg iodine per day for 2 weeks, assuring that there was no iodine shortage in the glands. A large part of the thyroid of each person was removed and the thyroglobulin separated and purified.[1] The total iodine and thyroxine iodine were then determined. The results compared with the normal were as follows:

Basal metabolic rate at time of removal of thyroid	Normal	+14 per cent.	+15 per cent.	+33 per cent.	+45 per cent.	+66 per cent.
Per cent. thyroglobulin in thyroid	20	15	19	8	12	6
Per cent. iodine in thyroglobulin	0.57	0.577	0.534	0.4	0.4	0.20
Per cent. thyroxine-iodine in thyroglobulin	0.25	0.162	0.156	0.115	0.1	0.04
Ratio $\frac{\text{Thyroxine-iodine}}{\text{Total iodine}}$	0.44	0.28	0.29	0.29	0.25	0.20

Hektoen and his collaborators have detected thyroglobulin in the thyroid vein and lymph by serological methods, and it has been assumed that the high metabolic rate is due to more rapid passage of thyroglobulin into the blood. These data show that it would require an unusually large amount of this thyroglobulin to account for the observed rise in basal metabolic rate as it is low in thyroxine, the case of highest basal metabolic rate being in a person whose thyroglobulin contained only 0.2 per cent. thyroxine (0.04 per cent. thyroxine-iodine).

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MAY 25, 1934

DISSOCIATION IN ERWINIA AMYLOVORA (BURRILL) COMM. S.A.B.[1]

IN a study of morphological, cultural and pathogenic variability in the fire blight organism the phenomenon of dissociation was observed.

The "rough" type was obtained by growing the "smooth" form in common nutrient broth of pH 6.9 for twenty days at temperatures from 12 to 25° C. Some isolates yielded 100 per cent. roughs in response to this treatment, while many showed the presence of a large number of intermediates. Many bouillon cultures stored from four to nine months at room temperature showed abundance of rough types upon streaking on nutrient agar plates. Another method of inducing dissociation consisted in daily transferring (at intervals of 18 hours) into bouillon of pH 6.9 and incubating at 28° C. With some isolates this method produced almost 100 per cent. roughs after 20 to 25 transfers.

The rough colonies appeared large, flat, wrinkled and dull. They were firm when touched with the needle and formed clumps when suspended in 0.85 per cent. NaCl solution. The individual bacteria of the rough type were motile but less so than those of the smooth type. The rough type showed a slight pathogenicity to pear shoots and avirulence to certain shrubs, which were very susceptible to the smooth type.

Rough and intermediate types were isolated from old natural infections of pear, apple and some shrubs.

Reversion of R to S was found to take place in 2 per cent. sucrose or 1 per cent. dextrose bouillon after four to six transfers. On the other hand, the organism was attenuated by sucrose concentrations of 10 per cent. or higher.

The comparatively easy reversibility of R into virulent S type, and the fact that the nectars of species susceptible to the fire blight disease may reach concentrations of sugars of from 2 to 5 per cent. in air of high relative humidity[2,3,4] may be suggested to have some bearing on epiphytotics of the fire blight disease.

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[1] Cavett and Seljeskog, "The Preparation of Thyroglobulin," *Proc. Soc. Biol. Chem., Jour. Biol. Chem.*, 100: xxvi, 1933.

[1] Contribution from the Division of Plant Pathology, University of California, Berkeley, Calif.

[2] Ruth Beutler, "Biologisch-chemische Untersuchungen am Nektar von Immenblumen," *Zeitschr. f. vergl. Physiol.*, 12: 72–176. 1930.

[3] H. E. Thomas and P. A. Ark, "Nectar and Rain in Relation to the Fire Blight Disease." In press.

[4] George H. Vansell, "Bee Behavior as Affecting Pollination." In manuscript.

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